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PREVALENCE OF UROPATHOGENS AND ITS ANTIBIOTIC SUSCEPTIBILITY PATTERNS ISOLATED FROM HEALTH SETUPS IN DISTRICT LOWER DIR

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Abstract

Urinary Tract Infections (UTIs) are prevalent and pose a significant health burden globally, affecting individuals of all ages. Females are particularly vulnerable due to anatomical factors, with UTIs occurring more frequently in women compared to men. Various risk factors contribute to UTI susceptibility, including poor personal hygiene, catheterization, and certain medical conditions. The rising prevalence of antimicrobial resistance among uropathogens complicates treatment decisions, highlighting the importance of collaborative efforts between clinicians and microbiologists in diagnosis and management. A recent study conducted in Dir Lower analyzed 200 urine samples from individuals with UTI symptoms, revealing a higher prevalence among females. UTI occurrence varied across age groups, with higher rates observed among younger and middle-aged individuals. Gram-negative bacteria, particularly Escherichia. Coli (44.04%), Klebsiella pneumoniae (36.78%), and Pseudomonas aeruginosa (10.36), species were the predominant uropathogens, with varying susceptibility to common antibiotics. High resistance against ciprofloxacin and ampicillin was noted, emphasizing the urgent need for antimicrobial stewardship to address multi-drug resistance and preserve antibiotic efficacy.

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INTRODUCTION

Urinary tract infections (UTIs) are a major global health issue, with approximately 150 million cases reported annually worldwide (1). These infections occur when pathogenic microorganisms are detected in aseptically collected urine and are among the most prevalent bacterial infections in humans, despite the urinary tract's inherent defense mechanisms (2). The prevalence of UTIs varies between 1.4% and 5.1%, with women being disproportionately affected due to anatomical factors, such as a shorter urethra located near the perianal region (3). Although UTIs are less frequent in men, the incidence in women over the age of 65 reaches around 20%, and nearly 60% of adult women are expected to experience at least one UTI during their lifetime. Clinically, UTIs present with symptoms including bacteriuria, frequent urination, urgency, dysuria, and lower abdominal pain (4). A wide range of pathogens can cause UTIs, including both Gram-negative and Gram-positive bacteria, as well as fungi. Among these, uropathogenic Escherichia coli is the most common causative agent of both uncomplicated and complicated UTIs. Other notable Gram-negative pathogens include Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, and Enterobacter species (5). The gold standard for UTI diagnosis is urine culture and antimicrobial susceptibility testing, with a threshold of $\geq 10^5$ colony-forming units per milliliter (CFU/ml) of a single bacterial species in midstream urine samples particularly in girls considered definitive for infection (6).

Urinary tract infections (UTIs) are classified based on severity, risk factors, and clinical presentation into complicated, uncomplicated, and recurrent UTIs. Complicated UTIs are associated with structural and functional abnormalities of the genitourinary tract, such as urinary blockages caused by tumors, stones, and catheters, and can result from conditions like Benign Prostatic Hyperplasia (BPH), carcinomas, nephroblastomas, renal cysts, pyelonephritis, and strictures (7). Uncomplicated UTIs, on the other hand, occur in individuals without any functional or anatomical abnormalities in the urinary tract. These are further categorized into lower urinary tract infections (cystitis) and upper urinary tract infections (pyelonephritis) (8). Symptoms of cystitis include painful urination, polyuria, and the presence of bacteria and pus in urine, while acute pyelonephritis is characterized by fever, lumbar pain, and the presence of bacteria and pus cells in urine (9). Escherichia coli is the leading cause of uncomplicated UTIs, followed by other strains such as Klebsiella, Pseudomonas, Proteus, Staphylococcus aureus, and Enterococcus. Recurrent UTIs, defined as more than two infections in six months or more than three infections per year, are often caused by reinfection, though relapse cases require longer treatment, extensive urological evaluation, and sometimes surgery (10). While recurrent uncomplicated UTIs are common in young, healthy women with normal urinary tract anatomy, complicated recurrent UTIs occur due to structural abnormalities. Asymptomatic bacteriuria, where bacteria are present in the urine without symptoms, can be risky, especially for pregnant women, kidney transplant recipients, and immunocompromised individuals (10). If left untreated, asymptomatic UTI can progress to symptomatic UTI, potentially leading to complications like pyelonephritis and kidney failure. The risk of infection increases in patients with urinary tract instrumentation and indwelling catheters, with Staphylococcus aureus being a particular concern in such cases (11).

Antimicrobial resistance (AMR) is widespread across the globe, from the Americas to Australasia (12). According to estimates by the Center for Disease Control (CDC), antibiotic-resistant bacteria cause at least 2.8 million illnesses and 35,000 deaths in the United States alone annually (13). A study of trends of AMR in Europe observed that gram-negative uropathogens had high resistance to some of the most common antimicrobials. A north-to-south gradient in AMR exists in Europe, with higher resistance among southern European states like Greece, Cyprus, France, and Italy (14). In a study of AMR in Asia pacific, "reduced sensitivity to commonly prescribed advanced-generation cephalosporin, piperacillin-tazobactam, and levofloxacin, among the studied gram-negative pathogens - Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, Enterobacter spp (ESKAPE) were observed" (15). One of the causes of antibiotic resistance is the empirical treatment of UTI (16). In India, resistant bacterial infections resulted in 58,000 infants deaths in 2013 (17). In the first and second years of life, infants and toddlers spend around 40 days on antibiotics, which clearly illustrates antibiotic overuse (18). 85% of children with acute otitis media, below two years of age, are prescribed antibiotics (19). Around 500 million courses of antibiotics are used to treat both bacterial and viral diarrhea each year across four middle-income countries India, Indonesia, Nigeria, and Brazil (16). Nevertheless, antibiotic abuse for a diarrheal disease is a leading cause of increasing antibiotic resistance (ABR) (20). Therefore, the regional antibiotic susceptibility patterns of the microorganisms should be used for treatment. World Health Organization's global plan of action on AMR has stressed AMR surveillance across nations as an important strategy for countering AMR (21). This study is one of the few addressing antibiotic susceptibility and resistance patterns in Baluchistan, Pakistan. More extensive AMR surveillance data is the need of time.

The present study aims to bridge critical knowledge gaps in the epidemiology, microbiology, and antimicrobial resistance patterns of urinary tract infections (UTIs) in Dir Lower. While previous research has provided important insights into the local burden of UTIs, a broader and more nuanced understanding remains limited due to the absence of comparative data from neighboring districts and a lack of focus on key demographic determinants such as socioeconomic status and healthcare accessibility. Moreover, the spectrum of uropathogens is often narrowed to well-known bacteria, overlooking the emergence of novel or resistant strains that may contribute significantly to disease burden. This study, therefore, focuses on the isolation and characterization of prevalent uropathogens from clinically diagnosed UTI patients in Dir Lower, assessing their distribution and prevalence across the local population. In addition, it investigates antibiotic susceptibility patterns to identify resistance trends and inform appropriate therapeutic strategies. By addressing these critical gaps, the study not only enhances our understanding of UTI dynamics in the region but also contributes to the development of more effective, evidence-based interventions for managing and preventing UTIs, particularly in the face of rising antimicrobial resistance.

Method and Methodology

Sample Collection

Each patient was directed to the laboratory after completing history. All patients were instructed on how to collect samples aseptically prior to sample collection to avoid contaminations. Mid-stream urine was collected in early morning. Urine was collected from each patient in sterile bottle. All bottles were labeled with patient history like serial No., case No., name of the patient, time and date of collection and with sex either male or female. The samples were processed as soon as possible. If processing was late, the samples were placed in refrigerator. The samples were examined to detect different microorganisms from urine.

Assessment of urine specimen

Microscopy

The samples of urine were taken in a tube and were centrifuged at 3000 -3500 rpm for five minutes in a centrifuge machine. After centrifugation, supernatant was discarded, and a drop of sediment was taken on dry and clean slide and was examined under a microscope by using 10X and 40X.

Samples Processing

The samples were collected from the patients in sterilized, wide mouthed glass bottles. Early morning mid-stream urine was collected in hygienic condition. The standardized germ-free wire loop for the semi-quantitative technique was practiced streaking with 4.0-mm span aimed for the transport of 0.01 ml. The loop filled with the thoroughly agitated urine was introduced on the blood agar, MacConkey agar or on CLED (Cysteine Lactose Electrolyte Deficient) agar. After inoculation, all plates were incubated for 24 hours at 37°C in aerobic condition. The plates were examined microscopically for bacterial growth. After 24 hours if growth occurred then slide was made for further examination. Then Gram Staining was performed to detect either the bacteria is Gram positive or Gram negative. After that colonies of the bacteria were calculated and then multiplied by 100 to extract a bacterial estimation of urine per milliliter. An important bacterial calculation was used as any calculation which is same to or greater in amount of 10,000 CFU/ml.

Incubation and Purification

After incubation, colony morphology was observed. Mixed cultures were subcultured for purification on fresh CLED, MacConkey, and Blood agar plates. Pure isolates were further processed.

Identification of Bacterial Isolates

Identification was performed through Gram staining and observation of colony morphology, followed by biochemical characterization using standard tests such as the catalase test, coagulase test, citrate utilization test, indole test, and oxidase test.

Antibiotic Susceptibility Testing

The Kirby-Bauer disk diffusion method was employed on Mueller-Hinton agar to evaluate antibiotic sensitivity. The medium was autoclaved and poured into sterile Petri dishes. After solidification, bacterial inocula were uniformly spread, and antibiotic discs were placed aseptically.

Tested antibiotics included:

CIP (Ciprofloxacin), GEN (Gentamicin), CFM (Cefixime), CTX (Cefotaxime), AMC (Amoxicillin-Clavulanate), FOS (Fosfomycin), IMP (Imipenem), AMP (Ampicillin), and AK (Amikacin).

Plates were incubated at 37°C for 24 hours, and the zones of inhibition were measured using a calibrated ruler. Results were interpreted according to CLSI (Clinical and Laboratory Standards Institute) guidelines, categorizing isolates as sensitive, intermediate, or resistant.

CHAPTER
RESULTS

Isolation and identification

200 urine samples were obtained from individuals exhibiting symptoms of UTIs in Dir Lower. The samples were collected in sterile screw-capped containers and tested at Fazal Rahim Clinical Laboratory in Timergara, Dir Lower. For bacterial isolation, identification, and susceptibility testing, a total of 200 samples were analyzed in this study. Of these, 94 (47%) were collected from males and 106 (53%) from females. Three urine samples from females and four from males showed no growth and were considered negative. All positive urine samples underwent bacterial culture, resulting in bacterial growth on the selected media, as shown in Figure 1.

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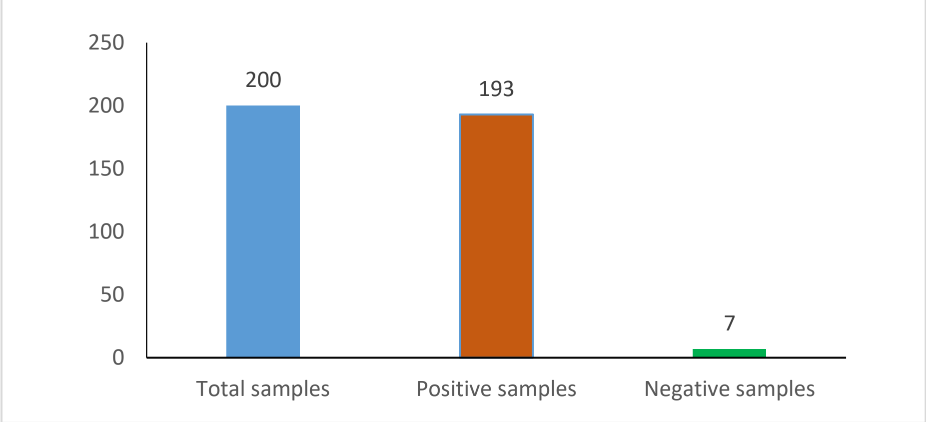

Figure 1: The figure illustrates the distribution of 200 urine samples. Of these samples, 193 (96.5%) were positive, while a small portion, 7 (3.5%), showed no bacterial growth upon testing and were deemed negative as shown in Figure 1.

Gender wise distribution of positive and negative sample results

In the current study, a total of 200 urine samples were analyzed to investigate urinary tract infections (UTIs). Of these samples, 94 (47%) were collected from male patients, while 106 (53%) were collected from female patients. Upon examination, it was found that approximately 103 (97%) urine samples from females and 90 (96%) samples from males exhibited bacterial growth and were thus considered positive. This data, along with further analysis, is presented in Figure 2, providing insights into the gender-wise distribution of UTIs within the study sample set.

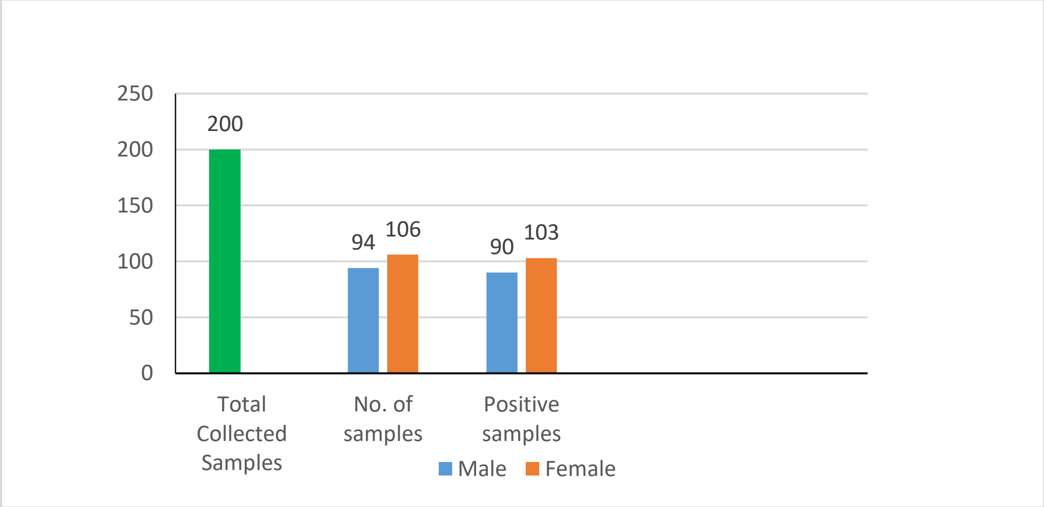

Figure 2: The figure illustrates the distribution of 200 urine samples by gender wise distribution of positive samples in the study. Of these, 94 samples collected from males, and 106 were from females. Among the male samples, 90 (96%) tested positive, while in the female group, 103 (97%) showed positive results of the total samples collected. This figure provides a clear overview of sample distribution and the occurrence of positive results across genders.

Distribution of UTI Patients by Age Group in the Study Sample Set.

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Participants in the study were categorized into five age groups: 0-20, 21-40, 41-60, 61-80, and 81-100 years. In the 0-20 age group, 34 samples were collected, with 9 from males and 25 from females; 33 out of 34 samples tested positive. For the 21-40 age group, 66 samples were collected, comprising 35 males and 31 females, and 64 of these tested positive. In the 41-60 age group, 58 samples were collected, with 33 from males and 25 from females, all of which tested positive. For the 61-80 age group, 41 samples were collected, consisting of 19 males and 22 females, and 39 samples tested positive. In the 81-100 age group, only 1 sample from a male tested positive out of the total collected. This data is summarized in Table 1.

Table 1: Distribution of Age wise UTIs patients in the study sample set

Age Group (years)	Total No. of samples	Male	Female	Positive samples
0-20	34	09	25	33
21-40	66	35	31	64
41-60	58	33	25	58
61-80	41	19	22	39
81-100	01	01	00	01
Total	200	97	103	195

Distribution of Species wise Uropathogens Among Patients in the Study Sample Set.

In the current study, analysis of urine samples revealed 10 samples as gram positive, while 176 samples were gram negative, and 7 samples exhibited mixed growth, contributing to a total of 193 positive samples. Among the gram positive uropathogens isolated, Staphylococcus aureus was identified in 10 cases, representing 5.18% of the positive samples. Conversely, among the gram-negative isolates, Escherichia coli was the most prevalent, found in 85 cases (44.04%), followed by Klebsiella spp in 71 cases (36.78%), and Pseudomonas spp in 20 cases (10.36%). The distribution of these bacterial species followed the order: Escherichia coli > Klebsiella spp > Pseudomonas spp > Staphylococcus aureus. This data is presented in detail in Figure 3, providing valuable insights into the prevalence and distribution of uropathogens in the study sample set.

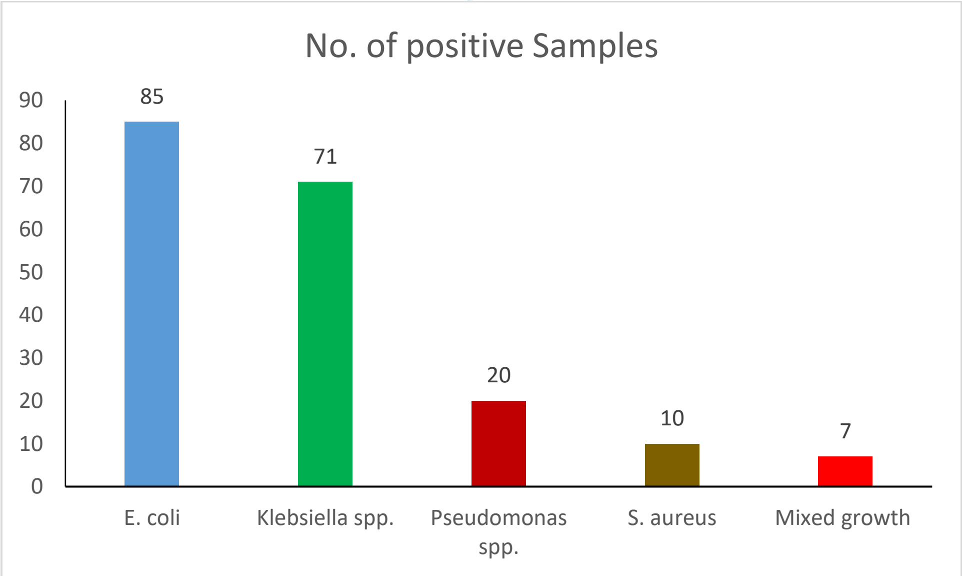

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Figure 3: The graph illustrates the distribution of uropathogens isolated from urine samples. Among 193 positive samples, Staphylococcus aureus (gram positive) was found in 10 cases, while Escherichia coli (gram negative) was the most prevalent, detected in 85 cases. Klebsiella spp and Pseudomonas spp were also identified, with 71 and 20 cases respectively. Escherichia coli was the most frequently isolated uropathogen, followed by Klebsiella spp, Pseudomonas spp, and Staphylococcus aureus.

Gender wise distribution of Uropathogens

The analysis revealed variations in the occurrence of different uropathogens between males and females. Escherichia coli, a gram-negative bacterium, was notably more prevalent in females, accounting for 23.8% of positive cases compared to 20.2% in males. Conversely, Klebsiella spp was more frequently observed in males, with a prevalence of 15.5%, while in females, it accounted for 21.2% of cases. Pseudomonas spp showed a higher occurrence in males (7.2%) compared to females (3.1%), and Staphylococcus aureus growth was slightly higher in females (3.1%) than in males (1.5%).

Furthermore, mixed bacterial growth was observed in both genders, with slightly higher occurrences in females (2.0%) compared to males (1.3%). Overall, the findings suggest a higher rate of occurrence of Escherichia coli, Klebsiella spp, and Staphylococcus aureus in females, whereas Pseudomonas aeruginosa was more prevalent in males. These results underscore gender-specific differences in the distribution of uropathogens, as showed in Figure 4.

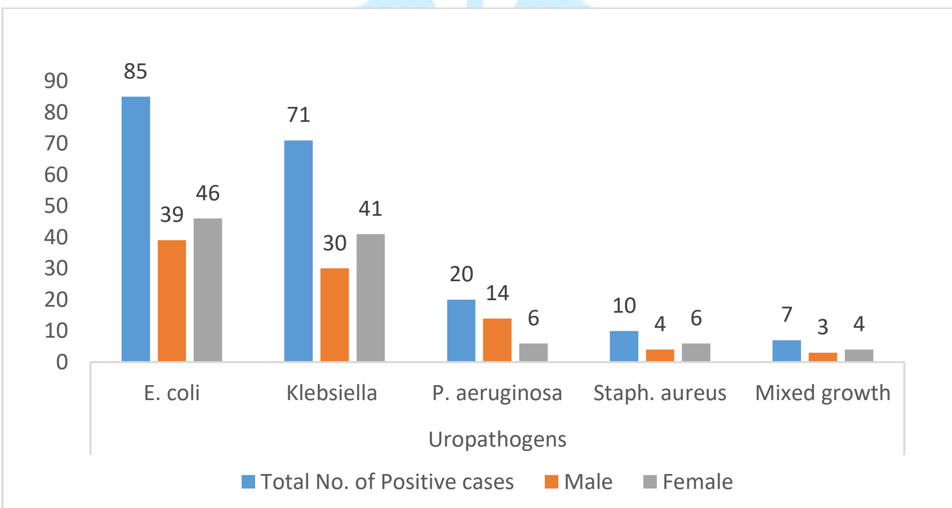

Figure 4: The figure illustrates gender-specific differences in the prevalence of uropathogens among males and females. Escherichia coli was more prevalent in females (23.8%) compared to males (20.2%), while Klebsiella spp showed higher incidence in males (15.5%) versus females (21.2%). Pseudomonas spp was more common in males (7.2%) than females (3.1%), and Staphylococcus aureus growth was slightly higher in females (3.1%) than in males (1.5%). Mixed bacterial growth was observed in both genders, with slightly higher occurrences in females (2.0%) compared to males (1.3%). This data highlights gender-specific variations in uropathogen distribution.

Antibiotic sensitivity

The antibiotic susceptibility profiles of four isolated bacterial species, namely Escherichia coli, Klebsiella, Pseudomonas, and Staphylococcus aureus, were tested against commonly used antibiotics: Ciprofloxacin, Gentamicin, Cefixime, Ceftriaxone, Co-amoxiclav, Fosfomycin, Imipenem, and Ampicillin, as showed in Table 3.2. Each species' susceptibility to various antibiotics is delineated through three categories:

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susceptible (S%), intermediate susceptible (IS%), and resistant (R%). Escherichia coli, a common Gram-negative bacterium, displayed high sensitivity to Fosfomycin and Imipenem, with percentages of 90.59% and 89.42%, respectively. Fosfomycin, known for its efficacy against a wide range of bacterial infections, exhibited notable effectiveness against Escherichia coli. Imipenem, a potent carbapenem antibiotic, also showed high sensitivity against Escherichia coli strains, highlighting its importance in treating infections caused by this bacterium. Similarly, Klebsiella displays heterogeneous susceptibility patterns across different antibiotics. While gentamicin exhibits relatively high susceptibility, ciprofloxacin and cefixime show limited effectiveness, with high rates of resistance observed. Notably, imipenem shows promising results, indicating its potential as a treatment option for Klebsiella infections. Pseudomonas isolates demonstrate concerning levels of resistance across most antibiotics tested, with high rates of resistance observed for ciprofloxacin and gentamicin. However, imipenem displays moderate susceptibility, indicating its importance as a potential treatment option for Pseudomonas infections. In contrast, Staphylococcus aureus exhibits relatively favorable susceptibility patterns, with high susceptibility observed for gentamicin and imipenem. However, resistance to certain antibiotics like ampicillin is prevalent, suggesting the need for careful antibiotic selection in clinical practice.

Table 2: Antibiotic Susceptibility Pattern of bacterial Isolates

Antibiotics	Escherichia Coli (n=85)			Klebsiella (n=71)			Pseudomonas (n=20)			Staphylococcus aureus (n=10)		
	S%	IS%	R%	S%	IS%	R%	S%	IS%	R%	S%	IS%	R %
Ciprofloxacin	25.88	4.70	69.41	35.21	00	64.78	15	00	85	50	10	40
Gentamicin	58.82	2.35	38.82	61.97	2.81	35.21	20	00	80	80	00	20
Cefixime	11.76	4.70	83.52	21.12	1.40	77.46	10	00	90	30	00	70
Ceftriaxone	11.76	7.05	81.17	18.30	1.40	80.82	15	00	85	80	00	20
Co-amoxiclav	5.88	4.40	89.41	26.76	7.04	66.19	10	00	90	40	30	30
Fosfomycin	87.05	3.52	9.41	83.09	5.63	11.26	50	00	50	90	00	10
Imipenem	88.23	1.17	10.58	90.14	1.40	8.45	30	00	70	100	00	00
Ampicillin	3.52	00	96.47	8.45	00	91.54	05	00	95	10	00	90

Overall, the table 2 provides valuable insights into the antibiotic susceptibility profiles of these bacterial species, highlighting the importance of judicious antibiotic use and the need for continued surveillance of antibiotic resistance patterns to inform effective treatment strategies and combat the emergence of multidrug-resistant infections.

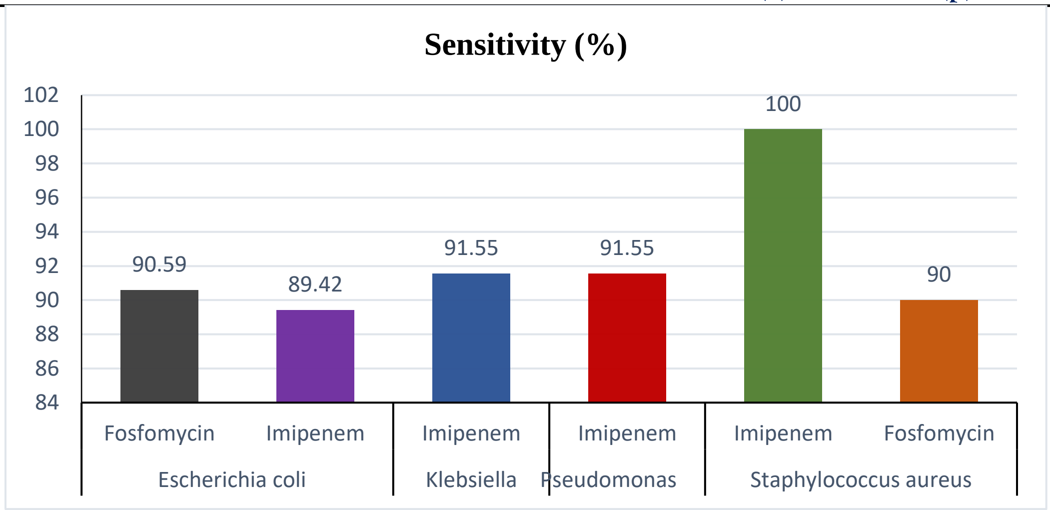

Figure 5: Antibiotic Sensitivity Pattern of bacterial Isolates

Table 3. Antibiotic Resistance Patterns Among isolated Uropathogens

Antibiotics	Escherichia Coli (n=85)	Klebsiella n=71)	P. aeruginosa (n=20)	Staphylococcus (n =10)
	Resistance %	Resistance %	Resistance %	Resistance %
Ciprofloxacin	69.41	64.78	85	40
Gentamicin	38.82	35.21	80	20
Cefixime	83.52	77.46	90	70
Ceftriaxone	81.17	80.82	85	20
Co-amoxiclav	89.41	66.19	90	30
Fosfomycin	9.41	11.26	50	10
Imipenem	10.58	8.45	70	00
Ampicillin	96.47	91.54	95	90

The data presented in Table 3 highlights the widespread prevalence of antibiotic resistance among four common uropathogens: Escherichia coli, Klebsiella, Pseudomonas aeruginosa, and Staphylococcus. High resistance rates are observed across various antibiotics, with notable inefficacy against ciprofloxacin and ampicillin. Conversely, fosfomycin and imipenem demonstrate comparatively low resistance rates. These findings underscore the pressing need for proactive measures to address antibiotic resistance, emphasizing the importance of prudent antibiotic use, surveillance, and the development of alternative treatment strategies. Furthermore, the data indicates the presence of multi-drug resistance (MDR) among certain bacterial strains, particularly P. aeruginosa, Klebsiella and Escherichia coli, which exhibit resistance to multiple antibiotic classes. This highlights the escalating challenge of MDR bacteria in healthcare settings and underscores the urgency for effective antimicrobial stewardship initiatives to combat the spread of resistant pathogens and preserve the efficacy of available antibiotics.

DISCUSSION

The urinary system, comprising the urethra, ureters, bladder, and kidneys, plays a vital role in filtering urea from the bloodstream through nephrons. Urine, thus produced, is then passed through to the bladder and urethra. However, the presence of infectious microorganisms in any part of this system can lead to Urinary Tract Infection (UTI). Females are particularly vulnerable due to their shorter urethra, making them more susceptible to pathogens. UTIs are significantly more prevalent in females, occurring 14-15 times

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more frequently compared to males (22). Factors such as poor personal hygiene, catheterization, urinary tract obstruction, and pregnancy contribute to this susceptibility (23). Children are also at risk, with 1-2% of boys and 4-5% of girls experiencing UTIs (24). UTIs rank third in frequency among infections, affecting people of all ages worldwide (2). Certain conditions like multiple sclerosis, diabetes, and AIDS can further predispose individuals to UTIs (3). Overall, UTIs pose a significant health burden globally, with millions diagnosed annually, underscoring the need for effective prevention and management strategies (25).

The rising global prevalence of antimicrobial resistance among microorganisms causing UTIs presents a significant challenge in selecting appropriate antibiotics for treatment. Local variations in antimicrobial susceptibility among uropathogens across different healthcare facilities further complicate treatment decisions. The diagnosis of UTI underscores the importance of collaborative efforts between clinicians and microbiologists.

In our recent study conducted in Dir Lower, 200 urine samples were collected from individuals displaying UTI symptoms. The study indicates a higher prevalence of UTI among female patients (51.5%) compared to males (45%). This study correlates with findings by Chowdhury and Parial (26). In their analysis, women comprised approximately 64.5%. Similarly, the studies of Bashir et al. (2008) and Getenet et al. (2011) also documented that Women are more prone to UTIs than men because, in females, the urethra is much shorter and closer to the anus (27).

The age wise data was analyzed to assess the frequency of UTI in different age groups. The study found that UTI prevalence varies across different age groups, with higher occurrences observed among younger and middle-aged individuals. Most samples tested positive in the group,21-40. The oldest age group had a lower incidence. This was in consistent with a study by Beyene et al. (2011) in which 53.5% was in the age group between 19 -39 years. Other studies also documented the same results (28, 29).

Likewise, upon analyzing all urine samples from 200 UTI patients, it was observed that the majority of bacterial infections were attributed to Gram-negative bacteria (E. coli, P. aeruginosa, and Klebsiella) at 91.1%, whereas Gram-positive bacteria (Staph, aureus) accounted for 5.1%. Previous research similarly noted a substantial predominance of Gram-negative bacteria compared to Gram-positive strains (30). Higher Gram negative uropathogens as compared to Gram positive organisms was also noted by Sneka et al (Gram negative 71% and Gram positive 27%) and Sharma et al (Gram negative 89% and Gram positive 11%) (31, 32).

The analysis highlighted variations in uropathogen occurrence between males and females. E-coli was more prevalent in females (23.8%) compared to males (20.2%), while Klebsiella spp was more common in males (15.5%) than females (21.2%). Pseudomonas spp showed higher occurrence in males (7.2%) than females (3.1%), and Staphylococcus aureus growth was slightly higher in females (3.1%) than males (1.5%). Overall, Escherichia coli, Klebsiella spp, and Staphylococcus aureus were more frequent in females, while P. aeruginosa was more prevalent in males. Similarly, several studies documented that E-coli, Klebsiella spp, and Staphylococcus aureus were more frequent uropathogens in females (32, 33).

In the current study E-coli emerged as the predominant gram-negative uropathogen, constituting 43.5% of cases, followed by Klebsiella spp at 36.4%, and P. aeruginosa at 10.2%. This finding is consistent with numerous studies: Mendem et al. reported similar figures at 49%, while Martin et al. found 41%. Conversely, lower rates were observed by Mechal et al. and Patel et al. at 36%, while higher figures were noted by Sneka et al. (61%), Bhansali et al. (56%), Pardeshi et al. (53%), Kalal et al. (54%), and Mohapatra et al. (68%) (31, 34-39).

Additionally, Chandrasekhar et al. documented E.coli as the primary uropathogen (48.6%), followed by Klebsiella spp (17.6%) and P. aeruginosa (4%) (33). Studies by Chowdhury and Parial and Galate and Bangde also support these findings (26, 40). Hammoudi's study identified

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Klebsiella spp (30.8%) as the primary isolate, followed by Staph, aureus (27.2%), E.coli (22.2%), Enterobacter (13.6%), Proteus (3.1%), and Pseudomonas spp (1.9%) (41). Variations in uropathogen prevalence may arise from environmental conditions, host factors, healthcare practices, socioeconomic standards, and hygiene practices across different regions.

According to our findings, the antibiotic susceptibility profiles of four bacterial species, E. coli, Klebsiella, Pseudomonas, and Staph, aureus, were examined against common antibiotics. E. coli showed high sensitivity to Fosfomycin and Imipenem, highlighting their effectiveness in treating infections caused by this bacterium. Klebsiella displayed varying susceptibility patterns, with gentamicin showing relative effectiveness and ciprofloxacin and cefixime displaying high resistance. Pseudomonas exhibited concerning levels of resistance to most antibiotics, although imipenem showed moderate susceptibility. Staph, aureus showed favorable susceptibility to gentamicin and imipenem but resistance to certain antibiotics like ampicillin. Several studies also reported varying degrees of findings with high susceptibility to imipenem and fosfomycin (31). Sharma et al. also demonstrated that most of the gram-negative uropathogens are sensitive to colistin (100%), fosfomycin (85%), amikacin (78%), gentamicin (76%), and meropenem (77%), while Gram-Positive Isolates showed maximum sensitivity to linezolid (100%), vancomycin (100%), fosfomycin (75%), gentamicin (72%), and doxycycline (65%) (32).

The current study also reveals widespread antibiotic resistance among common uropathogens, notably E. coli, Klebsiella, and P. aeruginosa. High resistance is observed against ciprofloxacin and ampicillin, while fosfomycin and imipenem show lower resistance. Multi-drug resistance is prominent, particularly in P. aeruginosa, Klebsiella, and E. coli, emphasizing the urgent need for antimicrobial stewardship to preserve antibiotic efficacy and combat resistant pathogens.

CONCLUSION

In conclusion, this study highlights the significance of urinary tract infections (UTIs) as a prevalent health issue, particularly among females and younger adults. The findings confirm that Gram-negative bacteria, especially E. coli, Klebsiella, and Pseudomonas, are the primary uropathogens responsible for UTIs. The study also reveals concerning levels of antibiotic resistance among these bacteria, emphasizing the need for antimicrobial stewardship and alternative treatment strategies. The variations in uropathogen prevalence and antibiotic susceptibility across different regions and populations underscore the importance of localized studies and collaborative efforts between clinicians and microbiologists to address this global health burden effectively. Furthermore, the high prevalence of multi-drug resistance among uropathogens, particularly P. aeruginosa, Klebsiella, and E. coli, necessitates urgent attention to preserve antibiotic efficacy and combat resistant pathogens. Overall, this research contributes to the understanding of UTI epidemiology and antimicrobial resistance, informing evidence-based approaches for prevention, diagnosis, and treatment of UTIs.

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